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send them in the hope that they may be made useful through the same channel, if you should think them worthy of publication :—

Station of Observation.	Phenomenon Observed.	Day of Obs.	Observed Time of Station.	Resulting Long. East of Greenwich.	Latitude of Obs. Station.
		1854	h m s	h m s	° ′ ″
D'Urban, Port Natal	Imm. of θ Ophiuchi	Aug. 4	9 16 18	2 4 16·9	29 52 48 S.
——	Em. of θ Ophiuchi	...	10 35 25	2 4 10·8	
		1855			
Port Elizabeth, Algoa Bay	Imm. of δ Libræ	April 4	13 16 11·4	1 42 18·6	33 57 36 S.
——	Imm. of α^2 Libræ	April 4	13 25 44·4	1 42 21·4	
——	Imm. of φ Sagittarii	April 8	14 34 28	1 42 21·9	

"The solar eclipse of November 20th, 1854, was also observed, but has not been calculated yet: the mean time of each contact was,—

Station of Observation.	Phenomenon Observed.	Day of Obs.	Observed Time of Station.	Latitude of Obs. Station.
		1854	h m s	° ′ ″
Port Elizabeth, Algoa Bay	Beginning	Nov. 19	22 24 57	33 57 36 S.
——	Ending	Nov. 20	0 57 16	

"All these observations were made with a refracting telescope by Fraunhofer.

"*2 Adelaide Street, Charing Cross, 1856, June 17.*"

Results derived from an Examination of certain places of the five principal Planets, as interpreted from Inscriptions on four old Tablets discovered in Egypt, made principally for Determination of the Epoch of the Tablets. By Mr. William Ellis, Assistant at the Royal Observatory, Greenwich.

(*Communicated by G. B. Airy, Esq., Astronomer Royal.*)

The tablets considered in this paper were discovered with other antiquities by the Rev. Henry Stobart during travels in Egypt in the years 1853 and 1854. The whole of these antiquities appear to have been afterwards submitted to the inspection of M. Brugsch, of Berlin, who seems to have soon discovered that the inscriptions on four small tablets, forming part of the collection, consisted of a long series of places of the five principal planets. The result of M. Brugsch's examination of these tablets is to be found in a pamphlet published at Berlin about the end of the year 1855, under the following title :—*Nouvelle Recherches sur la Division de l'Année des Anciens Egyptiens, suivie d'un Mémoire sur des Observations Planétaires, consignées dans quatre Tablettes Egyptiennes en écriture démotique.* M. Brugsch gives in this pamphlet a description of the appearance of the four tablets, accompanied by engraved copies of the same, and also his rendering of the Egyptian inscriptions, the epoch of them, however, being unknown,

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The following extract from the pamphlet will give some idea of the tablets :—

" I discovered in this collection four tablets of wood. . . . . . These tablets, the edges of which are raised a little above the rest of the surface, exhibit on both sides a great number of demotic inscriptions, written upon a coating of plaster, some in columns of black ink, and others in columns of red ink, in a state of good preservation, with the exception of some parts where the plaster has been detached, or where it has been concealed by a greyish brown crust. One of the sides of each of these four tablets is pierced with two holes in three different places, a circumstance which leads one to suppose that they were originally bound together, so as to form a sort of book.

" Upon the first inspection which I made of these inscriptions in presence of M. Henry Stobart, I at once ascertained that they contain a very rich series of astronomical observations relative to five stars."

M. Brugsch was led to conclude from an examination of these inscriptions,—

1. That the eight pages of the four tablets relate to astronomical observations made in the years 8–19 of the reign of an Egyptian king, and of the year 1–17 of his successor. 2. That these astronomical observations relate to the five planets. 3. That the large number of demotic figures which follow the name of each planet represent two series, of which the first does not exceed twelve, and the second is not greater than thirty. The conclusion that the first series serves to indicate the twelve months of the Egyptian year ; and the second, one of the thirty days of each month, is justified by the circumstance that in some instances we find, in the second series, the sign *o* (expressing in demotics the word *day*) followed by one of the numerical signs serving to designate the days of the month. 4. That the five epagomene days are there mentioned for the first time in demotic writing, and are employed for the first time in fixing dates in general. 5. That the series of dates of the days of the month placed under the name of each planet would appear to indicate the day of the planet's entrance into one of the signs of the zodiac, or its retrogradation out of the sign.

It should be mentioned that after the figures representing the month and the day, there follows a character indicating the particular sign of the zodiac. M. Brugsch gives his rendering of the complete series of planetary places, which extend over a period of 29 years. The order in which the planets appear in each year is as follows :—*Saturn, Jupiter, Mars, Venus, Mercury.* There are, however, many gaps in the places during the later years, arising from causes already mentioned. After a discussion relating to the Egyptian names for the five principal planets, M. Brugsch says :—

" I have confined myself to establishing as rigorously as possible the Egyptian names by which the planets were designated,

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It now remains to ascertain by calculation the epoch at which the observations consigned in these tablets were executed."

M. Brugsch concludes from the words "the year of the great house," which he met with in the course of his researches (an expression very frequently employed to designate the Roman emperors), that the tablets were written during the time of a Roman emperor. He remarks that the style of writing also applies very well to that epoch. The year 1 he accordingly concludes to be the first of the reign of an emperor. The year 19, which precedes, ought very naturally to designate the last year of the reign of his predecessor. This indicates the two reigns of Trajan and Hadrian, the former of whom reigned from 97 A.D. to 116 A.D., that is to say 19 years.

The following extract from the inscriptions on Tablet I., as interpreted by M. Brugsch, will serve as a specimen of the whole. The two sets of numbers in each column signify respectively the months and days according to the Egyptian calendar.

Name of Planet.	Years.						
	9	10	11	12	13	14	15
Saturn	1 1 ♐	1 1 ♑	1 1 ♑	1 1 ♒	1 1 ♒	1 1 ♒	1 ♓
—	3 5 ♑	...	5 14 ♒	...	7 24 ♓	3 24 ♓	4 ♈
Jupiter	1 1 ♌	1 1 ♍	1 22 ♎	1 1 ♎	1 1 ♏	1 1 ♐	1 ♑
—	12 28 ♍	...	...	2 21 ♏	3 18 ♐	4 5 ♑	18 ♒
—	...	...	...	...	...	8 15 ♒	5 ♓
—	...	...	...	...	...	10 26 ♑	
Mars	1 16 ♐	1 1 ♌	1 1 ♐	1 17 ♍	1 5 ♒	1 1 ♍	1 1 ♈
—	2 27 ♑	2 11 ♍	2 5 ♑	3 5 ♎	3 19 ♓	2 13 ♎	5 25 ♉
—	4 5 ♒	3 29 ♎	3 13 ♒	4 23 ♏	5 2 ♈	4 1 ♏	7 11 ♊
—	5 13 ♓	5 27 ♏	4 21 ♓	6 7 ♐	6 15 ♉	5 13	8 27 ♋
—	6 23 ♈	12 28 ♐	6 2 ♈	7 29 ♑	8 3 ♊	6 21 *	10 21 ♌
—	8 3 ♉	...	7 13 ♉	9 23 ♒	9 21 ♋	8 3	12 15 ♍
—	9 19 ♊	...	8 29 ♊	...	11 14 ♌	9 0	
—	11 1 ♋	...	10 13 ♋	...	Epag. 3 ♍	11 6	
—	12 22 ♌	...	12 1 ♌				

* or 25.

In the autumn of the year 1855, a manuscript copy of M. Brugsch's interpretation of the inscriptions on three of the eight sides of those Egyptian tablets was sent to the Astronomer Royal, who expressed a desire to have an examination made of the series of planetary places therein contained. The author accordingly obtained some results from them, which having come under the

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notice of M. Biot, that distinguished philosopher kindly furnished him with a copy of M. Brugsch's pamphlet, in consequence of which he was enabled to examine the whole series of planetary places.

In order to discover, if possible, the probable positions of the planets in the different signs on the Egyptian days named; whether entering the signs, or whether in any other particular parts of the signs; the Egyptian places of *Mercury* and *Venus* for several instances of inferior conjunction where retrograde motion appeared to be shown, were laid down in curves, together with the curves described by those planets at some inferior conjunctions in recent times, for comparison; and it was found that the retrogradation at inferior conjunction could only be properly represented, on the supposition that the Egyptian times referred to the time of entry of the different planets into the various signs, at the commencement of the sign when moving direct, and at the termination of the sign when moving retrograde. On any other supposition the places could not be made properly to correspond. It was, therefore, assumed, that in all cases the Egyptian times referred to the time of entry of the planets into the respective signs; at the commencement or termination of the sign according to the motion of the planet at the time.

For determination of the epoch of the planetary places, the following was the course pursued:—An examination of the places of the quick-moving planets, *Mercury* and *Venus*, showed, that at the beginnings of the Egyptian years these planets were generally in or near to the signs ♌, ♍, or ♎; as if the year commenced near to the autumnal equinox: a more attentive examination showed that at the commencement of the year the Sun must have been near the beginning of the sign ♍. For finding the epoch by trial, it was therefore assumed that the first month of the Egyptian year corresponded to the month of September, Julian reckoning; which assumption proved to be very nearly true. Then, on the supposition that the vague Egyptian year, consisting of 365 days, was used, the places would refer either to some time near to 1500 B.C., or to about 30 B.C. But supposing the fixed year to have been used, the places might refer to any time later than the time of the alterations of the Egyptian calendar made about 25 or 30 B.C. Therefore, admitting both suppositions, the places are confined either to about 1500 B.C., or to some time later than about 30 B.C. M. Brugsch's conjecture that the end of the first series of planetary places corresponds to the end of the reign of the Emperor Trajan, points to the latter period as the more probable one; independently of which, the former is so remote as to render it on that account alone less probable. Moreover, the zodiac was most probably not known in Egypt at so early a period. The later time was, therefore, first examined. The epoch was definitely fixed by means of the places of *Jupiter* and *Saturn*, in connexion with the places of *Mars*. The Egyptian places seem to show that at some time,—certainly in year 17, in the first series,—there was a conjunction

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in geocentric longitude of the planets *Jupiter* and *Saturn* in the sign ♈. But the geocentric longitudes of these planets never differ very greatly from the heliocentric longitudes. And as heliocentric conjunctions of *Jupiter* and *Saturn* occur at intervals of 20 years; each third conjunction, or those 60 years apart, taking place at an advance on the preceding one of 8° of longitude on the average, the intermediate conjunctions occurring at points 123° distant; it follows that in any particular sign of the zodiac, a series consisting of several conjunctions will take place at intervals of 60 years; after which no conjunctions will again happen in that particular sign for a space of about 700 years. On calculating, it was found that at about the commencement of the present era there were conjunctions of *Jupiter* and *Saturn* taking place in or near the sign ♈. Consequently if one of the conjunctions occurring near this time be not the one of year 17, it will be necessary to go backward or forward about 700 years, before conjunctions are found again to take place in ♈.

The approximate times of six successive heliocentric conjunctions near to the sign ♈ at the commencement of the present era, were in consequence calculated for trial, so as to include all geocentric conjunctions taking place in the sign ♈, with some which would occur in the signs ♓ and ♉. For each of these times the geocentric longitude of *Mars* was also calculated. Then assuming each conjunction in succession to have been that of year 17, the calculated places of *Mars* were compared with the corresponding Egyptian places in year 17, on the supposition that the Egyptian year commenced on September 1; comparing, however, those two instances so near the end of the Egyptian year with the places also from year 16. The results of the comparisons for the year 16 were found to be incongruous; those for the year 17 are contained in the following table:—

Approximate Longitude of Heliocentric Conjunction of Jupiter and Saturn.	Approximate Julian Time of Heliocentric Conjunction of Jupiter and Saturn.	Corresponding Egyptian Month and Day assuming 1st Month, 1st Day = Sept. 1.	Approx. Egyptian Longitude of Mars for preceding Egyptian Time from Year 17.	Cal. Geoc. Long. of Mars for Conjunc. of Jupiter and Saturn.	Difference between Egyptian Long. and Cal. Long for Year 17.
°			°	°	°
348	−6 Aug. 26	12th Month, 30th Day	173	217	44
357	54 Mar. 20	7th — 21st —	84	106	22
7	113 Oct. 22	2d — 22d —	69	67	2
18	173 May 9	10th — 1st —	116	322	154
28	233 Jan. 6	5th — 8th —	56	201	145
39	292 Aug. 22	12th — 27th —	172	101	71

In consequence of the very near agreement of the longitudes in the third instance, the place of *Venus* was calculated for 113 October 22; and the place of *Mercury* for 113, November 13; and compared with the corresponding places in year 17, supposing first month, first day = 113, September 1. The calculated geocentric longitude of *Venus* was found to be 195°, and that of *Mer-*

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cury 221°. The Egyptian places of *Venus* for 2d month 22d day, and of *Mercury* for 3d month 14th day, the times corresponding, were found to be 195° and 210° respectively; the difference for *Venus* being = 0°; and that for *Mercury* = 11°. Thus the places of all the planets agree within comparatively small limits on the supposition that year 17 of the tablets corresponds to 113 A.D., the difference for *Mercury* amounting only to a few days' motion. For each of the other conjunctions the place of *Mars* alone is discordant. It was consequently assumed that

	Egyptian.		Julian.
Series I.	Year 17, 1st Month	=	113 September

and this makes the end of the first series of Egyptian years correspond to the end of the reign of the Emperor Trajan, as was conjectured by M. Brugsch. The preceding examination shows the certainty with which the identification would have been made in the absence of any conjecture as to the probable epoch; and also how the places could be proved to correspond to no other epoch.

Having found the epoch of the planet places, the approximate commencement of the year, and also that the Egyptian times referred to the time of the different planets entering the zodiacal signs, a more accurate determination of the Julian commencement of the Egyptian year was attempted as follows. The Julian times of entry of the planets *Mercury* and *Venus*, into various signs, were found by calculation to the nearest civil day, taking that day on which the entry occurred nearest to noon, for several instances in every year, excepting those contained on Tablet III. The times taken were when the planets were moving direct and with tolerable rapidity, no other particular selection being made. Then by counting back the number of days elapsed from the beginning of the Egyptian year to the Egyptian time corresponding, the Julian time of commencement of the Egyptian year was inferred, as in the following instance in year 10 of the first series, for *Venus*.

Egyptian Date and Sign.	Calculated Julian Time of Entry of ♒ corresponding.	Inferred Julian Time of Commencement of Year 10.
Year 10, 7^{m} 1^{d} ♒	107, February 26	106, August 30

The mean date of the commencement of the Egyptian year found in this way from a great many places of *Venus* was:—

August $31^{d}\cdot4$

The places of *Mercury* treated in a similar way gave for the date of commencement of the year.

August $28^{d}\cdot2$

The result found from the places of *Mercury* thus differs by several days from that found from the places of *Venus*. A consideration, however, of the results as given by each planet

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separately, shows that the Egyptian year here used was evidently of equal length with the Julian year. It was, probably, the fixed Alexandrian calendar, as described in M. Biot's *Résumé de Chronologie Astronomique*, Vol. XXII. of the *Mémoires de l'Académie des Sciences*, in which the year commenced on August 29 Julian. The mean of the places of *Venus* and *Mercury*, August $29^{d} \cdot 8$, very nearly agrees with this date.

The author next proceeds to ascertain the date of the commencement of the year from the inferior conjunctions of *Mercury* and *Venus*, and from the recorded entrance of the superior planets into the various signs of the zodiac. The results are pretty accordant, and serve to confirm the conclusion at which the author had already arrived in reference to this point.

With respect to the question whether the Egyptian places are the results of observation or of calculation, the author has the following remarks :—

"As to the probability of the Egyptian places having been the result of actual observation, an examination of the places themselves seems to show that they do not possess the character of observations; the places of *Mars* being continuously given at each time of conjunction with the sun, when the planet for some time could not have been visible : those of *Jupiter* and *Saturn* are also occasionally given very near to the time of conjunction ; and those of *Mercury* and *Venus* appear to form nearly unbroken series, excepting that the instances of retrogradation of *Mercury* at inferior conjunction do not form an average, even when a deduction is made for those cases in which the retrogradation would be confined to the limits of one sign : in the case of *Venus*, however, there is quite an average number of retrogradations noticed. The curious discordances on Tablet III.* would also appear to show that the places are not the result of observation. They seem, indeed, to form a kind of planetary ephemeris, in which are given the successive times of entrance of the five planets into the 12 signs of the zodiac, as found by calculation, or by some equivalent method."

The author thus sums up the results which he considers to be derivable from the preceding examination :—

"1. That the dates attached to the different signs of the zodiac denote the times at which the planets entered those signs, according to the Egyptian calendar; either with direct motion at the commencement of the sign, or with retrograde motion at the termination of the sign, as the case may be ; excepting those instances in which the positions of the planets are given on the first day of the Egyptian year, in which cases the proper signification is merely, that at the beginning of the Egyptian year the planets were within the limits of the sign named, and not at the entrance of the sign : also, that as far as can be ascertained the position of the Egyptian equinox was correct.

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* The author gives a detailed account of these discordances in a preceding section of his paper.